Approach & processes

To meet growing consumer demand for seafood in the United States and world-wide, increasing supplies of finfish, shellfish and other seafood products will be needed. Most experts agree that development of aquaculture will be needed to meet this increase in demand. The challenge is how to ensure that increases in aquaculture production are sustainable.

The development and expansion of farming of carnivorous fish and shrimp species may soon be constrained by a limited supply of fish meal and fish oil for feeds. Fish meal and fish oil traditionally have made up a large part of the diet of farm-raised carnivorous fish and shrimp. The composition of these feed ingredients is almost perfectly matched to the dietary requirements of fishes. However, there is no dietary requirement for fish meal or fish oil for any organism. Because dietary requirements are not for the ingredients per se but for the nutrients they contain (e.g., amino acids, fatty acids, vitamins, and minerals), feeds that lessen the reliance on these limited ingredients—such as alternative protein and oil sources–can be developed.

For these reasons, the US Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and the US Department of Agriculture (USDA) sponsored expert and public consultations on the future of aquaculture feeds and the benefits to the U.S. economy by the development of such alternative feeds. These agencies were greatly aided in this effort by help and advice from scientists and others within the Department of the Interior (DOI) and the Food and Drug Administration (FDA).

The consultation process

The consultation process consisted of nine parts:

1. An invitation to the general public to comment on the issue, and respond to four questions designed to elicit input of a broad array of suggestions and approaches in the Federal Register. The public comments also helped indicate the level of understanding and knowledge that the public has regarding fish feeds. The Federal Register notice and unedited comments are available online at http://aquaculture.noaa.gov/news/comment.html.

2. A consultation with experts who are active researchers in the area of fish feeds, feedstuffs, nutrition, and related topics (scientific experts panel).

3. A consultation with experts who are active stakeholders in the area of fish feeds, feedstuffs, nutrition, and related topics (stakeholder experts panel).

4. Reporting case studies where the shift from reduction fishery fish meal and fish oil to alternatives is already happening or areas that might hold promise for the future. Case studies are featured after the report summary.

5. Futurecasts focused on fish feeds by the attendees at the two experts meetings.

6. Information from parts 1 through 5 above was summarized in this technical report addressing the questions raised by the public comment process, summarizing the results of the two experts panels, the future casts and reporting on the case studies.

7. A public review of the draft report to provide input before it is finalized.

8. Publication of the final report and outreach to interested parties.

Steering committee

A steering committee made up of scientists, federal policymakers, and communications experts was assembled to move the process through these steps. These individuals are listed on page iv.

The purpose of the steering committee was to fine-tune the objectives and questions asked, suggest and contact the appropriate scientists, develop dates and locations for panel meetings, choose facilitators for panel meetings, serve as reviewers of the draft report, and develop presentations to be given at public meetings. The editorial subcommittee assembled, wrote portions of, and edited the report. Numerous authors contributed case studies in their areas of expertise and/or in futurecasts.

In conducting this initiative, the steering committee was guided by several principals when considering an ingredient, process, or approach to reduce the use of conventional fish meal and fish oil in aquaculture:

- All ideas were welcome. The committee was more interested in what to do, rather than what not to do. Thus all ideas were welcomed equally. Conversely, objections to various feedstuffs are recorded but were not viewed as justification for their exclusion from consideration or exclusion from the final report.

- The committee attempted to adopt a triple bottom line approach when evaluating alternatives. This meant trying to account for:
    1. The economic performance of an ingredient, process, or approach.
    2. The environmental performance of procuring and using an ingredient, employing a process, or following an approach.
    3. The human health performance of the product resulting from the substitution of an ingredient, process, or approach.

Initial public comment process

The Federal Register notice containing questions to solicit input was published November 16, 2007 (http://aquaculture.noaa.gov/pdf/feeds_07fedreg.pdf). The public comment period ended February 29, 2008. The questions from the Federal Register notice were as follows:

- Where should the federal government focus its research efforts in the area of alternative feeds for aquaculture? Are there specific areas that the federal government should not address?

- What are potential alternative sources of protein and oil for aquaculture feeds? For example, are there specific opportunities for greater use of seafood processing waste and other agricultural by-products in aquaculture feeds? Are there specific obstacles to using these alternatives as alternative dietary ingredients in aquaculture feed?

- What type of treatments or processes show promise for improvement of existing aquaculture feedstuffs and for developing new feedstuffs? How soon could these technologies be commercialized?

- Fish meal and fish oil contribute important human nutritional components to aquaculture feeds such as omega-3 fatty acids. As the aquaculture feeds industry seeks to replace fish meal and fish oil with alternatives, how can the nutritional benefits of farmed seafood be maintained or enhanced? For example, what technologies exist for producing omega-3 fatty acids?

Experts panels

Two groups of experts were assembled to advance a path to the development of commercial aquaculture diets that have no or limited usage of fish meal or oil derived from commercial reduction fisheries. The first panel (scientific experts panel) was made up of scientists actively working and published in feeds and feedstuffs research, fish and human nutrition, bioenergy, processing, agriculture, and related areas. These scientists provided the scientifically defensible options for further development of alternative feed ingredients for aquaculture. This panel was primarily made up of university and government scientists from around the world. Scientists came from Australia, Canada, Japan, Norway and the United States. This panel met at NOAA's Manchester Lab in Washington State in February 2008.

The second panel (stakeholder experts panel) was made up of stakeholders who are experts in the practical areas of feeds, human nutrition, and specific feedstuffs; members of environmental groups and consumer groups; public hatchery system managers and members of the commercial aquaculture industry; and others with expertise related to the topic. They addressed the same charge as the scientific panel. This panel met at NOAA headquarters in Silver Spring, Maryland, in April 2008.

The expert panel workshops were used to capture expert opinions, develop consensus on key issues where possible, and vet options. Observers included government officials who are responsible for setting research funding priorities, regulators, and policymakers at the agencies with interests in feeds for aquatic organisms.

Both panels had the same four assignments:

1. Answer the questions resulting from the Federal Register announcement.
2. Identify the constraints and possible solutions to providing aquafeeds in the future as fish meal and fish oil resources become scarce.
3. Identify key research and technology transfer needs to overcome barriers for reducing reliance on fish meal and fish oil resources.
4. Predict the future of aquaculture feeds based on the first three items in this list.

Case studies

The steering committee solicited short write-ups from individuals who are already actively working to replace fish meal and fish oil. These seven case studies provide concrete examples of research leading to replacements, actual replacements being adopted by the aquaculture industry, or areas that hold great promise for replacement in the future. These case studies are listed after the summary section in this report.

Case studies included are:

1. Developing the potential of fish processing byproducts takes guts
2. From fish meal-dependent to fish meal-free: feeds research is producing the alternative diets of the future for trout
3. Plant-based feeds for black sea bass show promise
4. Shrimp farmers join with researchers to test new diets
5. Seaweed farming may be key for alternative aquaculture feeds
6. Research on diets for threatened and endangered fish species held in captivity gains ground
7. Soy products and aquaculture are a winning combination

Futurecasts

Both the researchers panel and the stakeholders panel provided the opportunity for each participant to provide their vision of the future of aquaculture feeds. At the end of each workshop, attendees were asked to spend some time thinking about and recording what they see as the state of feeds for aquaculture in the future. Specifically, participants were asked to predict the challenges and changes that aquaculture will face, and the developments that will affect both producers and consumers over the next 5 and 25 years. This information is summarized in the section on futurecasts from researchers and stakeholders panels. Because participants in each panel varied widely in background and expertise, they provided a variety of visions of the future. The unedited responses are presented following a short summary of all the futurecasts.